Rock,' and the 'Czar-liberator's Mountain.' One hundred and fifty photographs and sketches were taken, and a large number of geological and other specimens were collected. The expedition will no doubt have important scientific, and perhaps other results.

THE U. S. GEOLOGICAL SURVEY.[1]

THE plan of this volume is the same as that of its predecessors, comprising, first, the summary report of the director; second, brief administrative reports of the chiefs of divisions on the work accomplished in the several departments of the survey, with brief itineraries of the field-parties; and, third, the accompanying papers, which make up the main part of the volume, and are the only feature of permanent interest or value. These papers are the monographs or final reports finished during the year. The longer monographs appear here in abstract form only, being, like the more fragmentary bulletins, published separately for the use of specialists. But, although the annual volume is not a perfect *résumé* of the survey, it is wisely designed to present all the results of interest to the general reader.

The principal feature of Major Powell's summary report for 1882–83 is the preliminary statement of the proposed topographical and geological map of the United States, with the accompanying map showing the, for the most part, very limited areas which have been surveyed under the authority of the various states and of the general government, on a scale suitable for the present purpose. The scale adopted for the proposed map is 1:250,000, or about four miles to the inch, with contour lines for every twenty-five to two hundred feet, according to the character of the topography. It is proposed to publish this general map in atlas sheets, each being composed of one degree of longitude by one of latitude, in areas bounded by parallels and meridians.

Although the administrative reports indicate a larger amount of topographic and geologic work than for any previous year, the published results are comparatively meagre, the monographic portion of this volume falling decidedly below the average in extent, if not in general interest. The most important paper has only an indirect relation to the geology of the United States. This is Captain Dutton's able memoir on the volcanoes of the Hawaiian Islands. This work was not done at the expense of the survey, nor in anticipation of the annexation of the island kingdom to this country, but simply as a preparation for the study of the gigantic lava-flows of the Cascade Range in northern California and Oregon, — a work upon which Captain Dutton has since been engaged. Hence criticism of the survey for extending its operations beyond its legitimate field is forestalled, and the publication of this valuable contribution to our knowledge of the noblest of living volcanoes will undoubtedly be justified by the light which it will throw upon the volcanic phenomena of our north-western territories; for, while these are unparalleled among the eruptions of historic times, the evident liquidity and the vast volume of the lava plainly suggest the stupendous flows of Hawaii as the proper preparatory field of the student who would bring to their investigation the best comparisons that modern volcanism affords.

It is impossible here to do justice to the graphic descriptive chapters, which fully sustain the reputation achieved by the author for the bold and discriminating portrayal of geologic phenomena, in his reports on the plateau country and the Grand Cañon. But the highly important and original chapter on the volcanic problem may not be disposed of so summarily. Captain Dutton has here gathered together the principal facts and conclusions reached in his study of Mauna Loa and Kilauea, with a view to ascertaining whether they shed any new light upon the dark problem of the volcano. He goes to the root of the matter at once by calling attention to the fact that the volcano is essentially a heat problem, and that the final solution to be sought is an explanation of the origin of this heat and its modes of action.

The universal postulate that the earth's interior is throughout in a state of incandescence is accepted as a matter of course; but the question as to whether it is mainly liquid or solid is regarded as still in abeyance, and the determination of this point is not considered essential to the discussion of the volcanic problem. Against the view that the penetration of water to the seat of the internal fires is the cause of volcanic action, two objections are urged. 1°. The access of cold water would cool, and probably solidify, the lava. It might be claimed on the other side, however, that the water must be itself very hot before it reaches the lava, and that aqueo-igneous liquefaction takes place at much lower temperatures than dry fusion. The vaporization of the water would, however, absorb a large amount of heat. 2°. But this last consideration is rendered unimportant by the second objection; viz., that liquid water cannot pass the isogeotherm of 772° F. (the temperature of its critical point), and hence must be vaporized long before it reaches the lava.

That aqueous vapor may penetrate to the reser-

[1] *Fourth annual report of the U. S. geological survey to the secretary of the interior* (1882-83). By J. W. POWELL. Washington, *Government*, 1884. 8°.

voirs of liquid rock and be absorbed by it, as any gas would be by a liquid, is regarded as entirely possible, and not improbable. But great emphasis is properly laid upon the fact that this gradual absorption of hot vapor by hot lava would not create any tendency in the lava to explode or erupt, unless accompanied by a diminution of pressure or increase of temperature; and it is demonstrated at considerable length that no changes of temperature or pressure in the magma, of sufficient magnitude to merit consideration, are possible: consequently the balance of probability is regarded as inclining decidedly against the hypothesis that water is the cause of volcanic action. It does not appear, however, that Captain Dutton has taken any account of the important consideration, that, by the rising of the isogeotherms, water-impregnated portions of the earth's crust may conceivably attain a high degree of liquidity and expansive force; i. e., be made eruptible.

The hypothesis that volcanic energy is due to the penetration of oxygen to the unoxidized earth-matter below the crust is also rejected, mainly because it appears to be insusceptible of proof or disproof, postulating conditions beyond the reach of argument, but partly on account of the difficulty of finding a sufficient amount of oxygen. The statement, however, that some naturalists *imagine* that the earth's interior is imperfectly oxidized is certainly unwarranted, in view of the fact that basic lavas contain metallic iron and a vast amount of iron in a low state of oxidation.

Mallet's theory, that volcanic heat results from the mechanical crushing of the rocks when the crust yields to the powerful horizontal pressure due to the cooling of the interior, and mountain-ranges, rock-folds, and faults are produced, shares the same fate; chiefly because it is now probable that the cooling of the earth has been up to this time comparatively superficial, the infra-crustal regions being still as hot as ever. But Captain Dutton's argument is not conclusive, since he has simply shown that the corrugation of the crust must be ascribed to some other cause, such as the diminution of the earth's oblateness in consequence of the retardation of its rotation by tidal friction. The corrugation itself is an unquestioned fact, and, however produced, must have been attended by an enormous development of heat.

The fourth hypothesis examined assumes a local development of heat in the earth by unknown causes. This cuts the Gordian knot instead of untying it, but is rejected because its conditions preclude all discussions of its validity or adequacy. Relief of pressure would greatly promote the liquefaction and elastic expansion of lavas; but this is unconditionally rejected as a cause of eruptions, since denudation, the only cause of diminished pressure which Captain Dutton recognizes, cannot be correlated in its distribution with active volcanoes.

Having thus discredited all hypotheses of the origin of volcanic heat heretofore proposed, Captain Dutton advances no new view, but coolly demolishes our hope with the statement that Mauna Loa and Kilauea do not throw any more light upon the general problem than other volcanoes. He proceeds to show, however, that in other directions they have contributed something to our knowledge of volcanism. They are at once the largest and most active of volcanoes, activity being measured by the outflow of lava, and dissipation of energy. They agree with active volcanoes in general in standing on an area of elevation. That Hawaii has risen nearly three thousand feet in comparatively recent times, is regarded as clearly proved by the elevated beaches and terraces. The problem of the causes of elevatory movements is then attacked, and the numerous hypotheses are reduced to two alternative propositions; viz., the elevated portion of the earth has experienced an increase of matter, or it has undergone expansion. While local increments of mass are not ignored, the expansion hypothesis is accepted as the one agreeing best with the observed facts; and the tangential thrusts of the earth's crust are definitively rejected as a primary cause of vertical movements. Our author wisely refrains, however, from estimating what proportion of the altitude of the Alps and other mountain-ranges is due to the crumpling of their strata; this crumpling being unquestionably due to horizontal thrusts, and amounting in the Alps, according to Heim, to seventy-four horizontal miles. Hawaii, we are told, floats high because of the lightness of this part of the earth's crust, its relatively low density being due in part to its high temperature, and in part to the porosity of the lava, and the numerous and often large tunnels by which the entire island appears to be honeycombed. But no calculation is given of the increase of temperature required in a thin crust, with a reasonable coefficient of expansion, to produce an elevation of two or three miles in a non-volcanic region. It is not easy to see how the expansion hypothesis can survive application to really important instances of elevation.

Captain Dutton regards the Hawaiian volcanoes as immense columns of liquid lava with their accumulated overflows; and the upper ends of these columns, whether frozen over or exposing fiery lakes to the sky, are believed to be fundamentally unlike the craters of ordinary volcanoes. The

term 'caldera' is proposed and used as a general name for volcanic orifices of the Hawaiian type. As the column of lava gradually melts away the enclosing rocks, the caldera is enlarged by the falling-in of the surface, and it is not in any case due to explosions. Mauna Loa and Kilauea are clearly independent volcanoes; and we have no reliable indications that their activity is diminishing. The vast antiquity of the Hawaiian volcanoes is plainly shown, not only by their magnitude, but also by the wonderful progress of the agents of erosion, especially in those islands where the volcanic fires are now extinct. This is one of the principal topics discussed in the chapters on Maui and Oahu.

The abstract of the report by Mr. J. S. Curtis on the mining geology of the Eureka district, Nevada, supplements that by Mr. Arnold Hague on the general geology of the same district in the preceding volume. It is accompanied by sections of the principal workings, and discusses exhaustively the characteristics and probable origin of these singular ore-deposits, which had yielded sixty millions of dollars up to the close of 1882.

Following this is a short but useful chapter on popular fallacies regarding precious metal ore-deposits by Mr. Albert Williams, jun. Dr. C. A. White's review of the Ostreidae of North America, with an appendix by Mr. Heilprin, and thirty-eight plates, describes in simple yet scientific language all the known fossil species and the single living species of the Atlantic coast. A second appendix by Mr. Ryder, with eleven plates, is devoted to an interesting sketch of the life-history of the oyster.

The volume concludes with Mr. I. C. Russell's geological reconnaissance in southern Oregon, with two maps and sixteen small sections. This is a short but highly interesting account of the extreme northern part of the Great Basin, which is shown to possess the same structural and climatic features as the basin of Lake Lahontan, which bounds it on the south, and was described by the author in the annual report for 1881–82.

GEOGRAPHICAL NOTES.

Missionary maps. — The establishments of Les missions catholiques at Lyon, France, have issued an atlas containing data collected by the Catholic missionaries in various parts of the world. Beside the general maps, which resemble those of any good elementary atlas, there are some thirty detailed maps which have appeared from time to time in the organ of the missionary bodies. Numerous important additions to geography have been made by the missionaries; and, in bringing them together in convenient form, the atlas meets a real need. They appeared first in German, with explanatory text by Father O. Werner, and have been translated into French, with additions, by Valerien Groffier.

A newly discovered affluent of the Kongo. — The despatches from the Cape of Good Hope state that the expedition under Lieutenant Wissmann has discovered a new affluent of the Kongo, which will have an important bearing on the opening-up of the lower Kongo basin. Wissmann is on his way to Europe with the details. The new river is a powerful stream, over five hundred miles in length, between the equator and Stanley Pool. It is eight miles wide at its mouth, and quite deep. There were no obstacles to its navigation and the Pogge Falls, in the Tapende country, latitude 6° south, and longitude 22° east. Lake Lincoln, to be found on some charts, does not exist: the only lake encountered was Lake Leopold II., near the Kongo. The journey was made in large canoes constructed by the expedition, and a way was forced through the territory of savage cannibal tribes, who, if armed with guns instead of arrows, would have prevented their passage. In a single day as many as five conflicts took place, and several of the party were wounded, though none were killed. The journey was accomplished by Lieutenants Wissmann and Müller, a physician, artificer, and forty-six natives. The ferocity of the natives is accounted for by the fact that they had never seen white men or fire-arms. More details will soon be accessible. Meanwhile it seems more likely that the river is one of those which have been known only by report, rather than an entirely new discovery. The country is reported to be fertile, producing palm-oil, sugarcane, rice, and other tropical products.

Explorations in Central South America. — De Brettes sends a short note on his recent travels in the unexplored part of the southern district of the Gran Chaco, which began last March, and lasted forty-four days. He discovered a large salt lake (along which his party travelled nine days, and the west shore of which is estimated to be one hundred and thirteen miles long), also three rivers, running in a northerly direction, supposed to be tributaries of the Rio Vermejo. The south Chaco is flat, covered with thorns, mimosas, and tall herbage. The natives are hypocritical and cruel, and live in utter barbarism. After penetrating two hundred and twenty miles into the unknown region, the explorers were obliged by fever to retrace their steps to Corrientes. A new expedition was in contemplation.

Restoration of Lake Moeris. — The investigations of Mr. Cope Whitehouse in regard to the